M17/4/BIOLO/HP3/ENG/TZ2/XX/M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2017

Biology

Higher level

Paper 3

22 pages

Section A

Question			Answers	Notes	Total
1.	a		«apical» meristem/shoot apex ✓		1
	b		a. percentage survival is higher with larger diameter galls ***OR*** positive relationship ✓ b. variation/outlier at the lower diameters ✓ c. little variation in survival percentage at highest diameters ✓	 *OWTTE* *OWTTE*	2 max
	c		a. directional selection is when an extreme phenotype/characteristic is favoured ✓ b. flies that form small galls will be selectively predated ✓ c. over time, flies that produce small galls will become rarer ***OR*** mean gall size will increase ✓	*OWTTE* *OWTTE – accept vice versa*	2 max

2.	a		no effect with fructose diet but «statistically significant» reduction in control ✓		1
	b		a. effectiveness/effect of leptin depends on diet ✓ b. «if obese people have a» high fructose diet, then it will not suppress appetite ✓ c. «for obese people with a» control/low fructose diet, then it will suppress appetite ✓ d. results for mice may not be the same for humans ✓	*OWTTE* *OWTTE*	2 max
	c	i	adipose/fat tissue ✓		1
		ii	hypothalamus ✓		1

Question			Answers	Notes	Total
3.	a		xylem ✓		1
	b		a. pressure will decrease ✓ b. water volume decreases «in tube» due to evaporation transpiration ✓ c. «cohesion/tension of water column» causes increase in air volume «thus air pressure decreases» ✓	*OWTTE*	2 max
	c		***Alternative 1*** *humidity*: ***[2 max]*** a. outline of how independent variable is varied ✓ b. outline of control treatment ✓ c. control of other variable«s» ✓ ***Alternative 2*** *temperature*: ***[2 max]*** d. outline of how independent variable is varied ✓ e. outline of control treatment ✓ f. control of other variable«s» ✓	*eg: cover experimental plant«s» with a plastic bag* ***OR*** *mist the experimental plant«s».* *eg: control plant«s» is/are not covered/not misted.* *eg: light is kept constant.* *eg: place set-up under/away from heat lamps at different distances.* *eg: no heat lamp for control.* *eg: use hygrometer to verify that heat lamp does not change humidity level.*	2 max

Section B

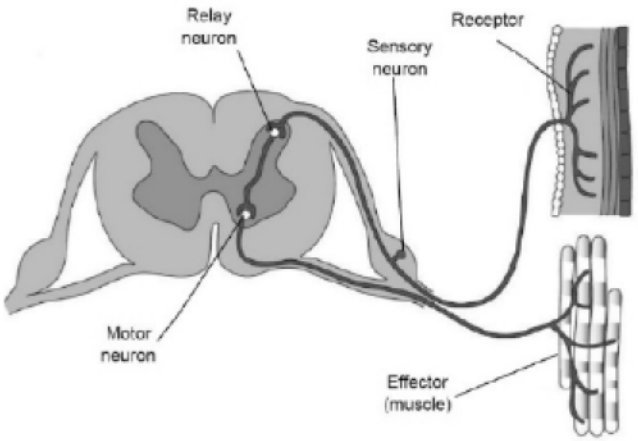
Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	a	i	a. *I*: neural groove/plate/fold ✓ b. *II*: ectoderm ✓		2
		ii	a. brain ✓ b. spinal cord ✓		2
		iii	spina bifida ✓		1
	b		a. human cortex larger than rat cortex ✓ b. human cortex proportionally larger than other brain parts than rat cortex ✓ c. surface area «of cortex» larger for humans ✓ d. more infolding of the surface of the cerebral cortex in humans ✓	*OWTTE*	2 max

Question			Answers	Notes	Total
5.	a		*difference in colour perception*: a. cannot distinguish red and green ✓ *reason*: b. green and red cones detect very similar wavelengths ***OR*** peak of altered green shifts to the right ***OR*** range of altered green wider «than normal green» ✓		2
	b		a. «movement of eardrum and ossicles» causes vibration of cochlear fluid ✓ b. hair cells in different position «along the basal membrane» have hair/cilia of different length ✓ c. different hair/cilia vibrate at different wavelengths ✓ d. «different hair cells send different» nerve signals in the auditory nerve ✓	*OWTTE*	3 max
6.	a		a. «cocaine» is an excitatory drug ***OR*** excitatory influence on the brain ✓ b. increase the concentration/level of dopamine in the synapse ✓ c. prolonged effect/continuous stimulus of dopamine on the brain/postsynaptic neuron ✓ d. addiction/dependence on high levels of dopamine for the same effect/addiction ✓	*OWTTE* *OWTTE*	2 max

(continued…)

(Question 6 continued)

Question			Answers	Notes	Total
	b		a. they contribute to memory/learning ✓ b. they modulate fast synaptic transmission «in the brain» ✓ c. by causing the release of secondary messengers in the postsynaptic neuron ✓		**2 max**
	c		a. receptor cell ✓ b. sensory neuron passes stimulus ✓ c. to interneuron/relay neuron ✓ d. which transmit response to motor neuron ✓ e. effector ✓	*Award marking points for a clearly annotated diagram.* *eg:*  	**3 max**
	d		olfactory «receptor» ***OR*** chemoreceptor ✓		**1**

Question			Answers	Notes	Total
7.	a		17.5 mm ***OR*** 15 mm to 20 mm ✓		**1**
	b		a. larger mussels too much effort to open ***OR*** best ratio between effort and energy return ✓ b. smaller mussels means more individuals have to be eaten for the same return on effort ✓ c. greater time/predator exposure spent during foraging to obtain required daily energy ✓ d. it «may be» the most common size available ***OR*** «correct mussel» size favoured by natural selection ✓ e. the claws are best adapted to prey on mussels of this size ✓	*OWTTE*	**3 max**

Question			Answers	Notes	Total
8.			*first method*: ***[3]*** a. name of first method ✓ b. how the first method works ✓ c. what can be learned from the first method ✓ *second method*: ***[3]*** d. name of second method ✓ e. how the second method works ✓ f. what can be learned from the second method ✓	*eg: lesion studies* *eg: carry out an autopsy* *eg: relate the position of the lesion to observed changes in behaviour* *eg: fMRI* *eg: inject dye into blood* ***OR*** *active parts of the brain have dyed blood flowing to them* *eg: known stimulus activates specific region of the brain that is detected* *Allow other verifiable methods.*	**6**

Option B — Biotechnology and bioinformatics

Question			Answers	Notes	Total
9.	a		a. alkali/base ✓ b. nutrients ✓ c. glucose/carbon source ✓ d. antibiotic ✓ e. nitrogen source ✓ f. water ✓	*Do not accept O_2 as air is blown in.*	**2 max**
	b		temperature ***OR*** optical density/turbidity ***OR*** oxygen ***OR*** CO_2 ✓		**1**

(continued…)

(Question 9 continued)

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td></td><td>c</td><td></td><td>
<table>
<tr><th>factor</th><th>batch</th><th>continuous</th></tr>
<tr><td>a. introduction of nutrients</td><td>at the beginning</td><td>all the time ✓</td></tr>
<tr><td>b. collection of products</td><td>all products at the end/OWTTE</td><td>small quantities throughout/OWTTE ✓</td></tr>
<tr><td>c. cleaning and sterilization</td><td>between batches</td><td>after a long time/OWTTE ✓</td></tr>
<tr><td>d. contamination</td><td>ruins only one batch</td><td>ruins the whole production ✓</td></tr>
</table>
</td><td></td><td>2 max</td></tr>
<tr><td></td><td>d</td><td></td><td>a. «genetically modify to» incorporate gene for low/blockage of TPS activity into A. niger ✓
b. «genetically modify to» incorporate gene that breaks down trehalose-6-phosphate ✓
c. selectively breed A. niger cultures for low/no TPS activity ✓</td><td></td><td>2 max</td></tr>
</table>

Question			Answers	Notes	Total
10.	a		a. in sterile solution/control there is no degradation of cyanide but there is in the solutions with *P. fluorescens* ✓ b. in solution containing *P. fluorescens* and sucrose degradation of cyanide higher than without sucrose ✓ c. control with sucrose «only» missing to establish causality ✓	*OWTTE* *OWTTE*	**2 max**
	b		«organic» carbon source «necessary for the reaction to degrade cyanide» ***OR*** sucrose provides the energy source ✓		**1**
	c		a. bioremediation is the use of organisms to degrade pollution/toxins in the environment ✓ b. *P. fluorescens* necessary to degrade cyanide which is toxic to the environment ✓ c. often involves supplementing with nutrients/carbon source/aeration ✓	*OWTTE*	**2 max**

11.			a. marker gene inserted into DNA containing target gene ✓ b. recombinant DNA «with marker gene and target gene» inserted into cell/organism ✓ c. named example of marker and target gene ✓ d. further details of how the marker gene works ✓	*eg: ampicillin resistance with BT gene for glyphosate resistance* *eg: culture cells in ampicillin and if the cell grows into a callus, uptake has occurred*	**3 max**

Question			Answers	Notes	Total
12.	a			*Accept other valid answers.*	**3 max**
			a. genetic markers/specific sequences can be present in people with a disease ✓	*OWTTE*	
			b. presence «of markers/specific sequences» indicates risk/probability of onset of condition ✓	*Allow vice versa.*	
			c. technique to detect the presence of the sequence ✓	*eg: PCR, electrophoresis, DNA sequencing, FISH, DNA databases, etc.*	
			d. example of predisposition ✓	*eg: BRCA sequence mutations indicating predisposition to breast cancer*	
	b		a. transferrin/other protein taken up at higher rates by tumour cells ✓		**2 max**
			b. transferrin/other protein can be labelled with a luminescent dye ✓		
			c. different tumour cell types can be distinguished/labelled in different colours ✓		
			d. can be used to highlight tumours «during surgery» ✓	*OWTTE*	

Question			Answers	Notes	Total
13.	a		a. «three» reading frames can occur in either strand ✓ b. from 5′ «to 3′» ✓ c. reading frame can start from any of the first three nucleotides ✓ d. from the top strand: GTG or TGA or GAA as first triplet ***OR*** from the bottom strand: ATA or TAT or ATT as first triplet ✓	*OWTTE*	**3 max**
	b		start codon/AUG ***OR*** stop codon/UAA/UAG/UGA ✓		**1**
	c		a. use a database ✓ b. conduct BLAST search ***OR*** BLASTn allows DNA sequence alignment ✓ c. «sequence alignment software used» to identify/compare similar sequences in different organisms ✓ d. gene function can be studied using model organisms with similar sequences with known function ✓ e. BLASTp allows protein alignment ***OR*** EST may be used to identify gene activity ✓ f. can change sequence and create “knockout” study organism ✓ g. changes in phenotype due to knockout procedure allow determination of function ✓ h. valid example provided ✓	*OWTTE*	**6 max**

Option C — Ecology and conservation

Question			Answers	Notes	Total
14.	**a**		reduction in number of species/diversity/richness ✓		**1**
	b		a. biological control of/reduction in corn pests ✓ b. reduction in the use of pesticides ✓ c. damage on beneficial species ✓ d. reduction in insect diversity can have broad ecosystem negative impact ***OR*** example of negative impact ✓ e. long-term effects unknown ✓	*OWTTE*	**3 max**
	c		*definition:* a. keystone species is one in which presence has a disproportionate impact on ecosystem ✓ *impact:* b. removal often leads to significant changes ***OR*** valid example ✓		**2**
15.	**a**		symbiosis/mutualism ✓		**1**
	b		producers ✓		**1**
	c		indicator species ✓		**1**

(continued…)

(Question 15 continued)

Question			Answers	Notes	Total
	d		a. eutrophication is nutrient enrichment of a body of water ✓ b. example of nutrients ✓ c. «nutrients» serve as fertilizer for the algae «promoting growth» ✓	*eg: nitrates*	**2 max**
	e		a. top-down factors refer to predation/herbivory/trophic level above another one ✓ b. which limit/control population growth ✓ c. named example of a top-down predator ✓	*eg: parrotfish* *Do not accept general names, like "fish".*	**2 max**

16.	**a**		the larger the area of the raft, the greater the number of species/diversity ***OR*** positive relationship/correlation ✓		**1**
	b		a. «consistent as» the theory of biogeography predicts an increase in diversity with increasing island area ✓ b. normally applied to much larger areas ✓ c. comparing the Eastern and Western Pacific samples, the same sized areas have significantly different numbers of species ✓ d. lack of resources «on plastic raft» may limit number of species ***OR*** other valid named factors besides area are influencing the number of species ✓	*OWTTE*	**3 max**

(continued…)

(Question 16 continued)

Question			Answers	Notes	Total
	c		a. plastics in the ocean can release toxins ✓ b. plastics are directly ingested/consumed ✓ c. toxins are absorbed by lower trophic level organisms ✓ d. toxins not metabolized by organism ***OR*** accumulate in tissues ✓ e. toxins concentrated in each successive level up the food chain ✓		**3 max**
	d		a. introduction of pathogens into areas where the pathogen is not found ✓ b. introduced species may become invasive ✓ c. animals can choke/become entangled ✓ d. any other valid concern	*Only mark the first two concerns written.* *OWTTE*	**2 max**
	e		*disadvantage*: a. biomagnification of DDT ***OR*** thin egg shells in birds of prey ***OR*** kills beneficial/other insects ✓ *advantage*: b. reduction in the levels of the malarial parasite ✓	*Accept any other valid disadvantage*	**2**

Question	Answers	Notes	Total
17.			6 max

Conditions		Tropical rain forest	Taiga
Nutrient stores	*Biomass (B)*	a. high levels «in biomass»	low levels ✓
	Litter (L)	b. low amounts of nutrient storage in litter	high amounts ✓
	Soil (S)	c. low amounts of nutrient storage in soil	low amounts ✓
Nutrient flows	*Transfer*	d. higher rates «S→B» «L→S» ***OR*** lower rates «B→L»	lower rates «S→B» «L→S» ***OR*** higher rates «B→L» ✓
	Leaching/run-off/ weathering	e. higher rates «not as high as other flows»	low rate ✓
Climate	*Temperature*	f. higher annual mean ***OR*** higher/warmer	lower average annual ***OR*** lower/colder ✓
		g. average annual temperature greater than 24 °C *«allow between 22°C and 26°C »*	–10 °C ***or*** –5 °C to 5 °C ✓
	Precipitation	h. high amounts of rainfall ***OR*** wet/wetter	much less rainfall ***OR*** dry/dryer ✓
		i. greater than 200 or 250 cm of rainfall annually	20–75 cm annually ✓

Option D — Human physiology

Question			Answers	Notes	Total
18.			a. determine the initial and final/change in mass of the food sample ✓ b. determine initial and final/change in temperature of water ✓ c. ignite sample and place burning sample under a known volume/mass of water ✓ d. energy content is determined using formula $\Delta T \times$ mass of water $\times$ specific heat capacity of water ✓ e. divide energy of water by mass of the food sample ✓	*OWTTE*	**3 max**

19.	**a**		a. «supported» as «all» structures smaller for anorexia ✓ b. «not supported as» overlap in error bars ✓ c. may not be reliable because of small sample ✓ d. other conditions unknown ✓ e. correlation does not necessarily establish causality ✓	 *OWTTE* *OWTTE*	**3 max**

(continued…)

(Question 19 continued)

Question			Answers	Notes	Total
	b	i	a. hypokalemia has a flat T-wave whereas hyperkalemia has a heightened T-wave ***OR*** hypokalemia S-T interval longer ✓ b. hypokalemia has narrower/faster QRS complex compared to hyperkalemia ✓ c. hypokalemia trace/baseline «overall» lower than hyperkalemia ✓	*OWTTE* *Accept vice versa* *Accept vice versa* *Accept vice versa*	**2 max**
		ii	a. arrival of signal at AV node ✓ b. transmission via conducting fibres/bundle of His/Purkinje fibres ✓ c. ventricles depolarize ✓ d. atrioventricular valves close ***OR*** semilunar valves open ✓ e. ventricular systole/contraction ✓ f. contraction begins at apex/base ✓		**3 max**
		iii	a. use a defibrillator ✓ b. place electrodes on exposed chest of victim ✓ c. in a line with the heart in the middle of a diagonal line between the two paddles ✓ d. the device determines whether fibrillation is happening ✓ e. if it is, an electric discharge is given off to restore a normal heart rhythm ✓		**3 max**
		iv	around 7.4 ***or*** 7.35 to 7.45 ✓		**1**

(continued…)

(Question 19 continued)

Question			Answers	Notes	Total
		v	a. increased CO_2 lowers blood pH ✓ b. chemoreceptors in carotid/aorta detect lower pH ✓ c. signal/impulses to medulla «oblongata» ***OR*** signal/impulses to respiratory centre ✓ d. «from medulla/respiratory centre» to intercostal muscles/diaphragm ✓ e. ventilation rate increase occurs to expel CO_2 ✓		**3 max**

20.			a. *V. cholerae* produces toxin ✓ b. «toxin» causes ions to be pumped into «small» intestine ✓ c. drawing water into the intestine ✓ d. through osmosis ✓ e. leading to water loss through diarrhea/vomiting ***OR*** leading to dehydration ✓		**3 max**

Question			Answers	Notes	Total
21.			a. Kupffer cells phagocytose/engulf the erythrocytes ✓ b. hemoglobin is split into heme group and globins ✓ c. globins hydrolyzed to peptides/amino acids ✓ d. heme group separated into iron and bilirubin ✓		**3 max**

22.			a. receptors are proteins ✓ *steroid hormones:* ***[3 max]*** b. steroid hormones cross plasma membrane ✓ c. bind to receptor «proteins» in the cytoplasm of the target cell ✓ d. to form a receptor–hormone complex ✓ e. «the receptor–hormone complex» promotes the transcription of specific genes ✓ *peptide hormones:* ***[3 max]*** f. peptide hormones bind to receptors in the plasma membrane of the target cell ✓ g. binding of hormones to «membrane» receptors activates a cascade of reactions ✓ h. mediated by a second messenger inside the cell ✓ i. such as cAmp **or** Ca^{2+} calmodulin ✓		**6 max**